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(54) Camera apparatus

(57) A camera apparatus, by which a still picture photographed without data transfer to a personal computer can be viewed on the personal computer, includes an optical system, an imaging device (21) for converting a light signal of an object from the optical system into an electrical signal, an A/D converter (22) for converting the

electrical signal from the imaging device (21) into digital picture data, a data compression unit (28a) for compressing the picture data from the A/D converter (22) in a pre-set style based on a software program, and a data conversion unit (28, 31, 32) for converting compressed data from the data compression unit (28a) into data of a pre-set style that can be recorded on a floppy disc.

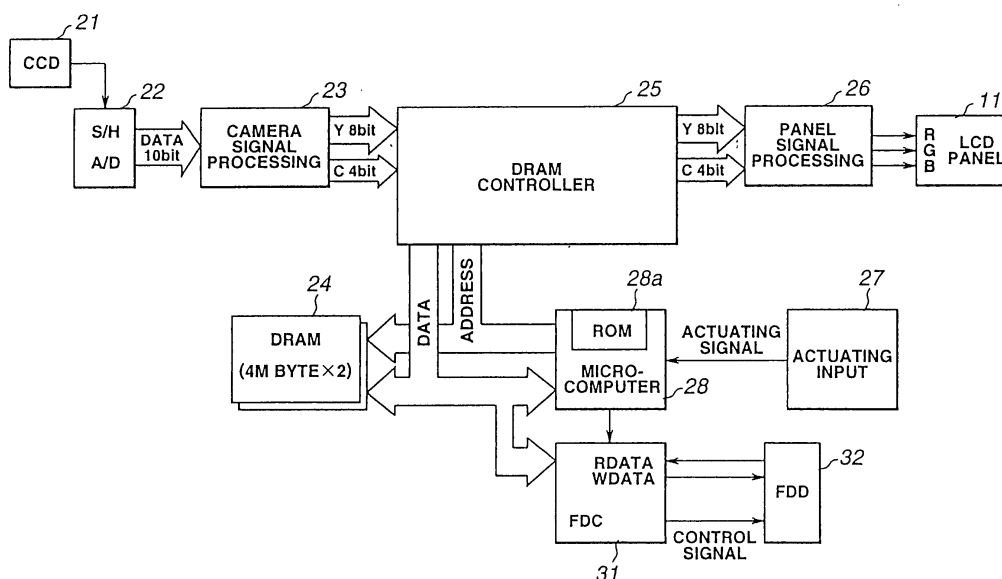


FIG.3

## Description

**[0001]** This invention relates to camera apparatus. More particularly, but not exclusively, the invention relates to a camera device for digitizing a picture of an object for recording as still picture data.

**[0002]** Recently, as personal computers are coming into widespread use, digital camera devices, configured for digitizing and recording pictures, are stirring up notice as picture recording devices. As the digital camera devices, there are known such devices in which a pre-set number of object are digitized and recorded in a pre-set recording medium such as a flash memory as still-picture data so that the still pictures can be subsequently outputted to a monitor of the personal computer. The digital camera device usually has the function as a picture reproducing device of displaying a picture recorded on a pre-set recording medium from a picture display unit, such as a LCD panel, provided on the back side of the device. In addition, the digital camera device occasionally has the function of editing picture data such as erasing a recorded picture corresponding to an unneeded picture or an unsatisfactory picture.

**[0003]** In a previously proposed digital camera device, a flash memory enclosed in a main body portion or a telescopically movable card-type flash memory is used as a recording medium for picture data.

**[0004]** However, in the previously proposed digital camera device, since these memories are expensive in terms of costs per photographed picture and hence is not suitable as storage medium, it is necessary to transfer the photographed still picture data to a hard disc or a floppy disc in the personal computer for copying after photographing, this data transfer representing a time-and labor-consuming operation. In the previously proposed digital camera device, these memories are costly such that the user cannot own a number of such memories, so that the number of pictures that can be photographed cannot be increased as desired, while the chance of photographing outdoors is restricted since the user cannot carry the personal computers outdoors.

**[0005]** The present invention provides a camera apparatus that includes an optical system, an imaging device for converting light signals of the object from the optical system into electrical signals, an A/D converter for converting the electrical signals from the imaging device into digital picture data, data compression means for compressing the picture data from the A/D converter in a pre-set style based on a software program, and data conversion means for converting compressed data from the data compression means into data of a pre-set style that permits recording on a recording floppy disc.

**[0006]** In a preferred form of the present camera apparatus described in detail hereinbelow, the light signals of the object from the optical system are converted by the imaging device, A/D converter, data compression means and data conversion means into pre-set data that permits recording on a floppy disc.

**[0007]** Since the light signals of the object from the optical system are converted by the imaging device, A/D converter, data compression means and data conversion means into pre-set data and subsequently recorded on the floppy disc, the photographed still picture can be easily seen on a personal computer on loading the floppy disc carrying recorded still picture of the object on the floppy disc drive of the personal computer. This eliminates the necessity of transferring the photographed still picture data to a hard disc or a floppy disc of the personal computer after photographing to dispense with the time-consuming data transfer operation.

**[0008]** Accordingly, the preferred form of the invention provides a camera device whereby a still picture photographed without data transfer to a personal computer can be viewed on the personal computer.

**[0009]** The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which:

Fig.1 is a perspective view from the front side of a digital camera device embodying the present invention.

Fig.2 is a perspective view of the digital camera device from the backside.

Fig.3 is a block diagram showing the circuit structure of the digital camera device.

Fig.4 represents the address space of a micro-computer.

Fig.5 represents a data area of a DRAM.

Fig.6 is a block diagram showing the circuit structure of the digital camera device.

Fig.7 is a flowchart for illustrating the control operation during data recording in the digital camera device.

Fig.8 illustrates filenames of main picture files.

Fig.9 illustrates the information on the filenames, recording time or file size of the main picture files and the thumbnail picture files.

Fig. 10 illustrates the state of the main picture files and the thumbnail picture files recorded on the magnetic disc.

Fig. 11 is a flowchart for illustrating readout control of the thumbnail picture files during reproduction in the digital camera device.

Fig.12 illustrates the hysteresis for the recording states on the magnetic disc.

Fig. 13 illustrates a thumbnail management table.

Fig.14 illustrates the state in which a thumbnail picture file is stored from a magnetic disc to a pre-set area on the DRAM.

Fig.15 illustrates the state of display of thumbnail pictures and so forth on a LCD panel.

Fig.16 is an exploded perspective view for illustrating the mechanical structure of the digital camera device.

Fig. 17 illustrates the mounting angle on a circuit substrate of an acceleration sensor.

Fig. 18 illustrates the mounting state of the circuit substrate and the floppy disc drive looking from the cartridge inserting opening side.

Fig. 19 is a see-through perspective view for illustrating the structure of the acceleration sensor.

Fig.20 illustrates the operation of the acceleration sensor on impact application.

Fig.21 illustrates the structure of a magnetic head arranged in the casing of the floppy disc drive.

Fig.22 is a timing chart for illustrating the operation of the acceleration sensor, flip-flop, OR gate, micro-computer and the floppy disc drive and the processing of recorded data.

Fig.23 is a block circuit diagram for illustrating a modification of the digital camera device.

**[0010]** Referring to the drawings, preferred embodiments of the present invention will be explained in detail. A digital camera device 1, embodying the present invention, is of a portable size and a substantially parallelepipedic shape, as shown in Fig.1 showing the appearance of the device from the front side. In the present digital camera device 1, a shutter button 3, an objective lens 4 and a flash device 5 are mounted on an upper portion of a casing 2. The shutter button 3 can be pressed with an index finger of the user's right hand.

**[0011]** On a lateral surface 6 of the casing 2 of the digital camera device 1 is mounted an opening/closing lid 7. From the lateral surface 6, a floppy disc cartridge 8 holding a floppy magnetic disc 9 of the size of 3.5 inch can be loaded into the inside of the casing 2. This floppy magnetic disc 9 is referred to herein simply as a magnetic disc 9. Specifically, as shown in Fig.2 showing the appearance from the back side of the digital camera device 1, there is arranged in the inside of the casing 2 a floppy disc drive 32 which will be explained subsequently in detail. The floppy disc cartridge 8 is inserted via a cartridge inserting opening 32a of the floppy disc drive 32 from the side of a shutter 8a.

**[0012]** On the back side of the casing 2 of the digital camera device 1 is mounted a liquid crystal display panel (LCD panel) 11 on which an object is displayed during photographing. If, in the digital camera device 1, the object is photographed by pressing the shutter button 3, there are recorded on a magnetic disc 9 in the floppy disc cartridge 8 loaded on the floppy disc drive 32 picture data of the object (main picture data) and thumbnail picture data operating as an index for the main picture data, in the form of files having extensions [.JPG] and [.JPG], respectively.

**[0013]** During reproduction of the main picture data after photographing the object, a thumbnail picture for thumbnail picture data recorded on the magnetic disc 9 is displayed for a pre-set number of pictures, such as six pictures, on the LCD display 11. If a particular one of the thumbnail pictures is designated, the main picture data corresponding to the thumbnail picture are read out from the magnetic disc 9 so as to be displayed on the LCD

panel 11.

**[0014]** The digital camera device 1 can erase unneeded main picture data and the thumbnail picture data recorded on the magnetic disc 9 or change the arraying manner of the thumbnail pictures displayed on the LCD panel 11, by way of a variety of editing operations.

**[0015]** That is, in the present digital camera device 1, a variety of actuating buttons/switches 12a, 12b, 12c, 12d, 12e, 12f and 12g are arranged around the LCD panel 11. By actuating these operating buttons, zooming during photographing, designation of particular thumbnail pictures during reproduction or data erasure can be executed by way of editing operations.

**[0016]** The opening/closure of the opening/closing lid 7 can be achieved by vertically moving an opening/closure actuator 13 for cancelling or holding the engaged state of engagement pawls 14a, 14b interlocked with the opening/closure actuator 13 with engagement portions 7a, 7b of the opening/closing lid 7.

**[0017]** The circuit configuration of the digital camera device 1 is hereinafter explained. Referring to Fig.3, the present digital camera device 1 includes a CCD21, as a photographing element, a sample-and-hold/analog-to-digital circuit, abbreviated hereinafter to a sample-and-hold circuit 22, a camera signal processing circuit 23, a DRAM 24 and a DRAM controller 25. The digital camera device 1 also includes a panel signal processing circuit 26, an actuating input unit 27, a micro-computer 28, a floppy disc controller or FDC 31 and the floppy disc drive or FDD 32, already explained with reference to Fig. 2. The panel signal processing circuit 26 furnishes RGB signals to the LCD panel 11. The digital camera device 1 also includes a flash memory 29 as an additional constituent element. The DRAM 24, DRAM controller 25, micro-computer 28, flash memory 29 and the FDC 31 are interconnected over a common bus.

**[0018]** In the digital camera device 1, light rays from an object are passed through the objective lens 4 and received by the CCD 21 so as to be thereby converted into electrical signals. An output signal from the CCD 21 is sample-held by the sample-and-hold circuit 22 and subsequently converted by A/D conversion into 10-bit digital signals. The converted 10-bit signals are sent to the camera signal processing circuit 23.

**[0019]** The camera signal processing circuit 23 processes the 10-bit digital signals supplied from the sample-and-hold circuit 22 in a pre-set manner to output the processed signals to the DRAM controller 25. The camera signal processing circuit 23 in the present embodiment generates 8-bit luminance signals Y and 4-bit chroma signals C from the input signal to output the signals Y and C to the DRAM controller 25.

**[0020]** The DRAM controller 25 directly sends the luminance signals Y and the chroma signals C from the camera signal processing circuit 23 to the panel signal processing circuit 26. If the CCD 21 is not of the tetragonal lattice structure, the camera signal processing circuit 23 forms the luminance signals Y and the chroma signals

C into signals of the tetragonal lattice structure to send the resulting signals to the panel signal processing circuit 26, which then generates red signals R, green signals G and blue signals B from the input luminance signals Y and chroma signals C to output the R, G and B signals to the LCD panel 11. This displays an image of the photographing object on the LCD panel 11.

**[0021]** The DRAM controller 25 also causes the luminance signals Y and the chroma signals C from the camera signal processing circuit 23 in pre-set areas of the DRAM 24 under control from the camera signal processing circuit 23. The DRAM 24 is made up of two 4 MB DRAMs, and thus has a storage area of 8 MBs.

**[0022]** The actuating input unit 27 detects the actuation contents of the shutter button 3 and the actuating buttons/switches 12a to 12g to output the detected signals as actuating signals to the micro-computer 28.

**[0023]** The micro-computer 28 is of the reduced instruction set computer RISC type capable of high-speed processing, and includes a read-only memory (ROM) 28a holding on memory a software program for controlling the respective blocks. The micro-computer 28 is responsive to actuating signals from the actuating input unit 27 to cause the software program in the ROM 28a to be executed to perform the processing such as picture compression or file management during the photographing, reproduction and editing.

**[0024]** Specifically, the micro-computer 28 causes the luminance signals Y and the chroma signals C to be stored during photographing of an object in a pre-set area of the DRAM 24 from the DRAM controller 25 in order to compress the stored luminance signals Y and chroma signals C in accordance with the JPEG (Joint Photographic Coding Experts Group) system. The micro-computer 28 also causes the data compressed in accordance with the JPEG system to be written in an area different from the above-described area of the DRAM 24 as JPEG stream data. The micro-computer 28 also causes JPEG stream data to be read out from the DRAM 24 to convert the JPEG stream data into MS-DOS (Microsoft Disc operating System, a trademark owned by MICROSOFT INC) format data to supply the converted data to the FDC 31. The micro-computer 28 controls the FDC 31 in order to write the data converted into the MS-DOS format data on a magnetic disc 9 of the floppy disc cartridge 8 loaded on the floppy disc drive 32.

**[0025]** Fig.4 shows the address space of the micro-computer 28. In Fig.4, the micro-computer 28 has an area 0000000~0ffffff as an area of an enclosed ROM, an area 2000000~2ffffff as an area for the FDC 31, an area 5000000~5ffffff as an area the enclosed peripheral module, an area 9000000~9ffffff as an area for the DRAM 24, an area e000000~efffff and an area f000000~fffff as an area for the enclosed RAM.

**[0026]** Fig. 5 shows a data area for the above-mentioned DRAM 24 of a sum total of 8 MBs. The DRAM 24 has an area 9f00000-9f77fff of 491025 bytes as an original picture data storage area for storage of picture data

for a sole main picture displayed on the LCD panel 11 (referred to hereinafter as area A). The DRAM 24 also has an area 9f78000~9f7ffff of 32768 bytes as a compression-expansion operating area for compression of the original picture data or expansion to original picture data (referred to hereinafter as area B). This area B also operates as an area for generating thumbnail data from the original picture data.

**[0027]** The DRAM 24 has an area 9f80000~9f87fff of 32768 bytes as a main routine common area as an operating area for the micro-computer 28 to execute a main routine during recording and reproduction (referred to hereinafter as area C), as will be explained in detail subsequently.

**[0028]** The DRAM 24 has an area 9f88000~9f8ffff of 32768 bytes allocated to a thumbnail picture storage area for storage of the file for thumbnail picture data (referred to hereinafter as area D), while having an area 9f90000~9fcfff of 262144 bytes and an area 9fd0000~9fffff of 19608 bytes allocated to a thumbnail image storage area for storage of thumbnail picture data (referred to hereinafter as area E) and to a JPEG file image storage area for storage of a file of main picture data generated under compression in accordance with the JPEG system (referred to hereinafter as area F), respectively.

**[0029]** Moreover, the digital camera device 1 includes an acceleration sensor 33 for detecting the impact from outside, an amplification circuit 34 for amplifying an output signal from the acceleration sensor 33 and a flip-flop 35 for setting an output signal from the amplification circuit 34. The acceleration sensor 33 outputs a detection signal in case of detection of an impact exceeding a pre-set G-value in a manner as will be explained in detail subsequently.

**[0030]** An output of the flip-flop 35 is supplied not only to the micro-computer 28 but also to the floppy disc drive 32 via one of input terminals of an AND gate 36. The micro-computer 28 also outputs a reset signal to the flip-flop 35.

**[0031]** The AND gate 36 has its opposite side input terminal connected to an output side of the FDC 31 for control signals and has its output terminal connected to the floppy disc drive 32 so as to perform the function as a gate (W gate) for issuing a permit/non-permit command for the recording operation by the floppy disc drive 32, as shown in Fig.4. The acceleration sensor 33 will be explained in detail subsequently.

**[0032]** The control operation during data recording in the digital camera device 1 is hereinafter explained with reference to Fig.7.

**[0033]** At step S1 after power up, the micro-computer 28 judges whether or not the floppy disc cartridge 8 has been loaded in position. If the floppy disc cartridge 8 is judged to have been loaded in position, the micro-computer 28 proceeds to step S9 and, if otherwise, to step S2.

**[0034]** At step S2, the micro-computer 28 causes the LDC panel 11 to display "no disc" by way of an alarm to

the user, and is in a standby state until the floppy disc cartridge 8 is loaded in position.

**[0035]** At step S3, the micro-computer 28 detects whether or not write protection is applied to the floppy disc cartridge 8, in order to judge whether or not writing on the magnetic disc 9 is possible. If the write protection is applied to the floppy disc cartridge 8, the micro-computer 28 proceeds to step S4 and, if otherwise, to step S5.

**[0036]** At step S4, the micro-computer 28 issues an alarm to the effect that writing cannot be made to terminate the processing. Specifically, a legend such as "disc protect" is displayed on the LCD panel 11.

**[0037]** At step S5, the micro-computer 28 controls the FDC 31 to reproduce a track 00 on the outermost rim of the magneto-optical disc 9 by the floppy disc drive 32 to read data recorded in the route directory in this track or in the file allocation table (FAT) area to extract the information such as the filename or the address present in the data area of the magnetic disc 9.

**[0038]** At the next step, the micro-computer 28 formulates a file list table in which to list the various items of the information extracted at step S5. The micro-computer 28 then lists the various sorts of the information extracted at step S5 before proceeding to step S7.

**[0039]** At step S7, the micro-computer 28 checks whether or not the magnetic disc 9 is formatted in accordance with the DOS/V style. If the result is affirmative, the micro-computer 28 proceeds to step S9 and, if otherwise, to step S8.

**[0040]** At step S8, to which the micro-computer 28 proceeds if the magnetic disc 9 is not formatted in accordance with the DOS/V style, the micro-computer 28 causes the legend "disc error" to be displayed on the LCD panel 11 to terminate the processing.

**[0041]** The micro-computer 28 is in a standby state at step S9 until release input. That is, the micro-computer 28 is in a standby state at step S9 until pressing of the shutter button 3 and proceeds to step S10 when the shutter button 3 is pressed.

**[0042]** At step S10, the micro-computer 28 causes picture data obtained on photographing an object in the area A of the DRAM 24 shown in Fig. 5 to retrieve the main picture.

**[0043]** At the next step S11, the micro-computer 28 compresses the picture data stored in the area A of the DRAM 24 in the area B in accordance with the JPEG system to generate main picture data, which is then stored in a file style in then area F of the DRAM 24.

**[0044]** At the next step S12, the micro-computer 28 decimates the main picture data, retrieved at step S10, to a pre-set data volume on the pixel basis in order to generate thumbnail picture data as sub-samples of the main picture. These thumbnail picture data are stored in the file style in the area B of the DRAM 24. Meanwhile, the digital camera device 1 decimates the data so that the thumbnail picture file will be of a pre-set capacity.

**[0045]** At the next step S13, the micro-computer 28 before proceeding to recording of each data refers to the

above-mentioned file list table in order to check the residual recording capacity of the magnetic disc 9. The micro-computer 28 compares the residual recording capacity to the sum of the recording capacity of the main picture data stored in the area F at step S11 and that of the thumbnail picture data stored in the area E at step S12 in order to check whether or not the residual capacity of the magnetic disc 9 suffices. If the residual capacity is judged to be sufficient, the micro-computer 28 proceeds to step S15 and, if otherwise, to step S14.

**[0046]** At step S14, the micro-computer 28 causes the legend "disc full" to be displayed on the LCD panel 11 to issue an alarm to the user to terminate the processing.

**[0047]** At step S15, the micro-computer 28 refers to the file list table to check the number of files already recorded on the magnetic disc 9 in order to judge whether or not limitations are imposed on the number of files. Specifically, it is judged whether or not limitations are imposed in case of adding the filenames of two files, namely the main picture file and the thumbnail picture file, to the track 00 of the magnetic disc. If limitations are imposed, that is if filenames can no longer be added, the micro-computer 28 proceeds to step S16. If otherwise, the micro-computer 28 proceeds to step S17.

**[0048]** At step S16, as at step S14, the micro-computer 28 causes the legend "disc full" to be displayed on the LCD panel 11 in order to issue an alarm to the user to terminate the processing. That is, at steps S13 and S15, it is judged whether or not, with the current state of the magnetic disc 9, the main picture file and the thumbnail picture file can be recorded in the disc.

**[0049]** At step S17, the micro-computer 28 formulates filenames of both the main picture file and the thumbnail picture file. The filename of the first main picture file is "MVS-001S.JPG", as shown in Fig. 8. On the other hand, the filename of the first thumbnail picture file associated with the main picture file is "MVS-001S.411". Specifically, "JPG" and "411" stand for extensions of the main picture file and the thumbnail picture file, respectively, with the main picture file and the thumbnail picture file being the same except these extensions.

**[0050]** It is noted that "MVC-" stands for the fixed appellation used for each main picture file and each thumbnail picture file in common, while "001" stands for serial number. The above-mentioned file list table is referred to in order to affix different numerals for the main picture files and the thumbnail picture files. The serial numbers range from 001 to 999, with the number obtained on adding 1 to the largest number on the disc being a new number. If, on referring to the file list table, there is a main picture file or a thumbnail picture file having the serial number 999, unused numbers from 001 are allocated.

**[0051]** Further, "S" stands for the degree of data compression of the main picture files and, in the present case, means that the main picture file is a file of data obtained on standard data compression. If the main picture file is data obtained on compression for high picture quality, this portion of the filename is "F".

**[0052]** At the next step S18, the micro-computer 28 formulates a main picture file allocation for recording the main picture file in a pre-set area of the magnetic disc 9. Specifically, an area is secured beginning from the outer rim of the magnetic disc 9 in order to set and hold on memory the area for recording the main picture file.

**[0053]** At the next step S 19, the micro-computer 28 controls the FDC 31 to write the main picture file by the floppy disc drive 32 in the area on the magnetic disc 9 as set at step S18.

**[0054]** At the next step S20, the micro-computer 28 formulates a thumbnail picture file allocation for recording the thumbnail picture file in a pre-set area of the magnetic disc 9. Specifically, the micro-computer 28 secures an area beginning from the inner rim of the magnetic disc 9 to set and hold on memory the area for recording the thumbnail picture file.

**[0055]** At the next step S21, the micro-computer 28 controls the FDC 31 to write the thumbnail picture file by the floppy disc drive 32 in the area on the magnetic disc 9 as set at step S20.

**[0056]** At the next step S22, the micro-computer 28 controls the FDC 31 to write in the route directory area and the file allocation table (FAT) area on the magnetic disc 9 by the floppy disc drive 32 the information on the filenames, recording time and file size of the main picture files and the thumbnail picture files recorded at step S 19 and S21. This is illustrated in Fig.9 in which the main picture files and the thumbnail picture files are the same in filenames except the extensions, with the ultimate editing time, herein the recording time, of the two files being also coincident. It is noted that the thumbnail picture files are of a fixed file size of 4806 bytes, while the main picture files are of variable file sizes depending on picture complexity.

**[0057]** At step S24, the micro-computer 28 transfers the thumbnail picture files from the area B of the area F of the DRAM 24. After the end of the processing at step S24, the micro-computer 28 reverts to the release input waiting state of step S9, and repeats the processing from step S9 to step S24 subject to the release input.

**[0058]** By the above-described processing, the main picture file and the thumbnail picture file are recorded from both ends of the disc, as shown in Fig.10A. For convenience in illustration, the filenames of the main picture files and the thumbnail picture files are abbreviated to A.JPG, B.JPG, ... and A.411, B.411, ..., respectively. Fig.10A shows how thumbnail picture files A.411, B.411, C.411 and D.411 are recorded when four main picture A.JPG, B.JPG, C.JPG and D.JPG files associated therewith are recorded in this order.

**[0059]** That is, in the present digital camera device 1, the main picture files are sequentially recorded and arrayed, beginning from the leading end of the disc data area, at the same time as the thumbnail picture files are sequentially recorded beginning from the trailing end of the data area. Meanwhile, the recording direction of the individual thumbnail picture files, that is the data writing

direction, is the same as the recording direction of the main picture files.

**[0060]** When recording data on the magnetic disc 9 in the non-recorded vacant state, the main picture files and the thumbnail picture files are alternately recorded in physically discrete areas of the magnetic disc 9, while the thumbnail picture data are continuously recorded from one end of the data area of the magnetic disc 9, so that plural thumbnail picture data can be read out promptly as if the data are a sole file, thus significantly reducing the readout time.

**[0061]** Also, since the thumbnail picture data only are recorded in a lump state, redundant data processing is eliminated. Moreover, since it is unnecessary for the main picture file to have the thumbnail information, there is no necessity for having dependence upon the file format of the main picture file.

**[0062]** As for the digital camera device 1, since the main picture files are recorded beginning from the position on the disc opposite to the thumbnail picture files, there is only one comprehensive vacant area on the magnetic disc 9 to allow for effective utilization of the entire data area of the magnetic disc 9 during data recording.

**[0063]** Meanwhile, since the magnetic disc 9, on which the respective data have been recorded by the present digital camera device 1, conforms to the MS-DOS format, data can be copied as usual by the DiscCopy command.

**[0064]** Fig.10B shows the case in which E.JPG as the fifth main picture file and E.411 as the thumbnail picture file of this main picture file have been additionally recorded beginning from the state of Fig.10A. Since there is some other data in this case downstream of the fourth main picture file D.JPG on the magnetic disc 9, the probability is high that the fifth thumbnail picture file E.411 shall be recorded in continuation to D.411 even if the recorded fifth main picture file E.JPG is not consecutive to D.JPG. Since the files are usually recorded with the floppy disc drive beginning from the outer rim of the disc, it is a frequent occurrence that the inner rim side of the disc is in an intact state.

**[0065]** Moreover, since the thumbnail picture file has a fixed capacity, the thumbnail picture file F.411, which should be recorded next to the thumbnail picture file C.411, deleted by editing, can be recorded in an area in which this thumbnail picture file C.411 was previously recorded. With the present digital camera device 1, if a specified thumbnail picture file is erased to produce a non-consecutive area for the thumbnail picture files on the magnetic disc 9, a new thumbnail picture file is recorded at the same time on the occasion of next recording in the non-consecutive area produced due to erasure of the thumbnail picture file. This recording method assures continuity of the respective thumbnail picture files on the magnetic disc 9, as will be explained in detail by taking specified examples.

**[0066]** The readout control of the thumbnail picture file at the time of reproduction with the digital camera device 1 is explained with reference to Fig.11.

**[0067]** In the digital camera device 1, the series of operations of steps S31 to S40, as now explained, are executed after entering the thumbnail readout mode.

**[0068]** The micro-computer 28 controls the FDC 31 at step S31 to cause the floppy disc drive 32 to reproduce the track 00 at the outermost side of the magnetic disc 9 to start reading out the information on the thumbnail files. The micro-computer 28 then proceeds to step S32.

**[0069]** At this step S32, the micro-computer 28 extracts file names of the effective thumbnail picture files. Specifically, the micro-computer 28 refers to the route directory area of the track 00 and the file allocation table (FAT) area to search the relation between the thumbnail picture files and the main picture files in order to judge whether or not the thumbnail picture file is effective based on possible presence of the associated main picture file and in order to extract only the filenames of the effective thumbnail picture file. If the check into the relation between the thumbnail picture files and the main picture files reveals that there is no thumbnail picture file associated with the pre-set main picture file, the micro-computer 28 records the information such as the filenames of the main picture file.

**[0070]** At the next step S33, the micro-computer 28 controls the FDC 31 to array the filenames of the extracted effective thumbnail picture files in the order of physical addresses of the magnetic disc 9.

**[0071]** At the next step S34, the micro-computer 28 formulates a thumbnail management table configured for relating the address of each thumbnail picture file with the main picture files as will be explained subsequently in detail. If there is no thumbnail picture file associated with the pre-set main picture file, as discussed in connection with the step S32, a blank image file, which will be explained in detail subsequently, is allocated to the pre-set main picture file on the occasion of formulation of the thumbnail management table.

**[0072]** At the next step S35, the micro-computer 28 controls the FDC 31 to read out by the floppy disc drive 32 one of the thumbnail picture files located on the outer rim of the magnetic disc 9 in order to store the read-out thumbnail picture file in a pre-set area of the DRAM 24. The micro-computer 28 then proceeds to step S36.

**[0073]** At this step S36, the micro-computer 28 judges whether or not the processing at step S35 has come to a close normally, that is whether or not a sole thumbnail picture file has been read out normally. If the processing is found to have come to a close normally, the micro-computer 28 proceeds to step S38 and, if otherwise, to step S37.

**[0074]** At step S37, to which the micro-computer 28 proceeds after finding that the processing at step S36 has not been terminated normally, the micro-computer 28 performs the processing on the assumption that there is no thumbnail picture file. The micro-computer 28 then proceeds to step S38. Specifically, the micro-computer 28 modifies the thumbnail management table and sets a pointer of establishing association with the above-men-

tioned blank image.

**[0075]** At step S38, the micro-computer 28 judges whether or not the thumbnail picture files have been read out up to the last file. If the result is affirmative, the micro-computer 28 proceeds to step S38 to terminate the processing and, if otherwise, the micro-computer 28 proceeds to step S39.

**[0076]** At step S39, the micro-computer 28 prepares for reading out the next thumbnail picture file before reverting to the above-mentioned step S35. Thus, the micro-computer 28 repeats the processing from step S35 to step S39 until reading all effective thumbnail picture files.

**[0077]** The operation in case data have been deleted from the magnetic disc is explained by referring to the drawings. For convenience in explanation, the filenames of the main picture files and the thumbnail picture files are abbreviated to 001.JPG, 002.JPG, ...and 001.411, 002.411, ..., respectively.

**[0078]** Fig.12 shows hysteresis concerning data recording and deletion on or from a given magnetic disc 9a. That is, in this magnetic disc 9a, a thumbnail picture file 005.411 associated with the fifth main picture file 005.JPG, has not been recorded by some reason at the time of recording of the fifth main picture file, as shown in Fig.12. With the present magnetic disc 9a, the main picture file 003.JPG and the associated thumbnail picture file 003.411 are deleted after recording the main picture files 001.JPG to 009.JPG and the associated thumbnail picture files 001.411 to 009.411 excluding 005.411 and the main picture file 010.JPG and the associated thumbnail picture file 010.411 are recorded after this deletion.

**[0079]** The operation during reproduction of the present magnetic disc 9a is explained by referring to the flowchart of Fig. 11.

**[0080]** At step S31, reproduction of the track 00 of the magnetic disc 9a is started by the floppy disc drive 32.

**[0081]** At step S32, 001.411, 002.411, 004.411, 006.411, 007.411, 008.411, 009.411 and 010.411 are extracted as filenames of effective thumbnail picture files. Since there is no thumbnail picture file (005.411) associated with the main picture file 005.JPG, a pointer is set at the filename of the main picture file 005.JPG.

**[0082]** At the next step S33, the filenames of the extracted effective thumbnail picture files are re-arrayed in the order of the physical addresses in the magnetic disc 9. In this case, the re-arraying sequence is 009.411, 008.411, 007.411, 006.411, 004.411, 010.411, 002.411 and 001.411. That is, since the thumbnail picture files are recorded beginning from the innermost rim of the magnetic disc 9a and 010.411 is recorded after deleting 003.JPG and 003.411, the thumbnail picture file 010.411 is recorded in an area between the thumbnail picture files 004.411 and 002.411.

**[0083]** At step S34, the thumbnail management table shown for example in Fig.8 is formulated. This thumbnail management table has columns for file numbers, main picture files and the associated thumbnail addresses. In

the present embodiment, the columns of the file numbers and the main picture files are arrayed in the recording sequence of the main picture files. In the column of the associated thumbnail addresses is stated the leading address in the area E for storage in this area of the DRAM 24 in accordance with the sequence of the re-arraying performed at step S33. As for the main picture file 005.JPG, for which there lacks the associated thumbnail picture file, a leading address of, for example, 0, is recorded as the leading address of the area on the DRAM 24 in which is stored the blank image file.

**[0084]** At the next step S35, the thumbnail picture file 009.411, located at the outer rim of the magnetic disc 9a, is read out and stored in an area up to an address number of a~b-1 of the area E in the DRAM 24. At step S36, it is judged that this thumbnail picture file has been read out normally. If the thumbnail picture file 009.411 has not been read out normally at step S35, the column of the address of the associated thumbnail in the thumbnail management table is rewritten at step S37 to 0.

**[0085]** At step S38, it is not all thumbnail picture files that are read out. Thus, processing transfers to step S39 to repeat the processing at steps S35 to S39 so that the thumbnail picture files are stored in the area E of the DRAM 24 in the sequence of 008.411, 007.411, 006.411, 004.411, 010.411, 002.411 and 001.411, as shown in Fig.9.

**[0086]** Since the thumbnail picture file 005.411 has not been recorded in the magnetic disc 9a, 006.411 is read after 004.411 in the pre-set area of the DRAM 24. Since there is the main picture file devoid of the thumbnail picture file on the magnetic disc 9a, a blank image displayed in place of the thumbnail file in the absence thereof is stored in a pre-set area (area a~b-1 in Fig.14) of the DRAM 24.

**[0087]** After all of the thumbnail picture files in the magnetic disc 9a have been stored in the DRAM 24, the micro-computer 28 controls the DRAM controller 25 and the panel signal processing circuit 26 for displaying six thumbnails on the LCD panel 11. Reference is had at this time to the thumbnail management table in order to display the thumbnails on the LCD panel 11.

**[0088]** This causes six thumbnails to be displayed on the LCD panel 11, as shown in Fig.15. Since there is no thumbnail picture file associated with 05.JPG, the filename of the main picture may be displayed in a grey picture having the same size as other photographed pictures.

**[0089]** With the digital camera device 1, the main picture file associated with one of the six displayed thumbnails is read out from the magnetic disc 9a based on the actuating signals of the actuating input unit 27. This main picture file is stored in a pre-set area of the DRAM 24 and expanded by the micro-computer 28 in accordance with the JPEG system for display subsequently on the LCD panel 11 to an enlarged size.

**[0090]** The internal mechanical structure of the digital camera device 1 is now explained. Referring to Fig.16, the casing 2 of the digital camera device 1 can be ex-

ploded into a front side half 2a and a rear side half 2b. In these front and rear side halves 2a and 2b are arranged a circuit substrate 41, a chassis 42 and the floppy disc drive 32. Specifically, the circuit substrate 41, chassis 42 and the floppy disc drive 32 are in the form of substantially co-extensive rectangles and arranged in the inside of the casing 2 so that the rectangles overlap with one another.

**[0091]** More specifically, the circuit substrate 41 has its four corners secured by plural set screws 43 on one of the major surfaces of the chassis 42 facing the front side half 2a, as shown in Fig.16. Also, the floppy disc drive 32 is mounted via four buffer members 45, 46, 47 and 48 for facing the opposite side major surface of the chassis 42 facing the rear side half 2b. The chassis 42, carrying the circuit substrate 41 and the floppy disc drive 32, is secured to the front side half 2a of the casing 2 by set screws 44 from the upper side and from the lateral side by set screws, not shown.

**[0092]** The circuit substrate 41 is substantially rectangular in shape in its entirety and has a variety of chips, such as LSIs, operating as blocks of the circuit shown in Figs.3 and 6. On the major surface 41a of the circuit substrate 41 facing the rear side half 2b is mounted the above-mentioned acceleration sensor 33 having a substantially rectangular profile, as shown in Fig.6. Specifically, the acceleration sensor 33 is mounted at an approximately lower rightward side of the major surface 41a of the circuit substrate 41 so that the long side of a substantially rectangular casing 61 is at an angle of approximately 45° relative to a lower side 41b of the circuit substrate 41, as shown in Fig. 17. The acceleration sensor 33 will be explained further in detail subsequently.

**[0093]** The chassis 42 is molded from metal, such as stainless steel, and has its major surface 42a recessed significantly. An upper flange 42b, a lower flange 42c and a side flange 42d are formed from the upper edge, lower edge and the right-side edge (Fig.16) of the major surface 42a of the chassis 42, respectively, in a direction facing the rear side half 2b.

**[0094]** The floppy disc drive 32 is of a thin type of a so-called 1/2 height having a casing 32 of metal. This floppy disc drive 32 is mounted on the chassis 42 by set screws via the four buffer members 45, 46, 47 and 48. Specifically, the upper flange 42b and the lower flange 42c of the chassis 42 and the buffer members 45 to 48 are provided with bores adapted to be passed through by set screws 49 to 52. These set screws 49 to 52 are passed through these bores and screwed into tapped holes formed in the corresponding positions of the floppy disc drive 32 for securing the floppy disc drive 32 to the chassis 42.

**[0095]** Referring to Fig.18, showing the mounting state of the circuit substrate 41 and the floppy disc drive 32 to the chassis 42 looking from the side of the cartridge inserting opening 32a, the casing 32b of the floppy disc drive 32 is not directly contacted with the major surface 42a of the chassis 42, such that the vibrations or impacts applied to the chassis 42 are transmitted via the buffer

members 45 to 48 to the floppy disc drive 32. As for the relation between the chassis 42 and the circuit substrate 41, since the circuit substrate 41 has its four corners secured to the major surface 42a of the chassis 42 by set screws 43, the vibrations or impacts applied to the chassis 42 are directly transmitted to the circuit substrate 41.

**[0096]** The buffer members 45 to 48 function to delay the time which elapses until the impact applied to the casing 2 from outside is transmitted to the floppy disc drive 32, and are formed of a relatively soft material, such as rubber, sponge, silicon or soft plastics. The buffer members 45 to 48 also function to weaken the impact applied to the casing 2 to some extent to transmit the thus weakened impact to the floppy disc drive 32.

**[0097]** In the present embodiment, the floppy disc drive 32 and the casing 2 are interconnected via the chassis 42. Alternatively, the floppy disc drive 32 and the casing 2 may also be interconnected without interposition of the chassis 42. In this case, it suffices if the casing 2 is provided with bores for traversing by the set screws 49 to 52 and the floppy disc drive 32 is mounted on the casing via the buffer members 45 to 48 by inserting the set screws 49 to 52 into these bores.

**[0098]** Referring to the see-through perspective view of Fig. 19, an impact detection plate 62 for detecting the impact is arranged in the inside of the casing 61 of the acceleration sensor 33. This impact detection plate 62 is substantially rectangular in profile in its entirety. Specifically, the impact detection plate 62 is formed as a thin girder by two piezoelectric ceramic plates 62a, 62b having electrodes at mid positions on its major surface, as shown in Fig. 20. The impact detection plate 62 has its longitudinal ends secured within the casing 61 and has the mid portions of the major surface thereof movable within the casing 61. Thus, if an impact is applied in the in-plane direction of the impact detection plate 62, this impact detection plate 62 is warped arcuately to issue a signal proportionate to the intensity of the applied impact.

**[0099]** This impact detection plate 62 is arranged in the inside of the casing 61 so that its long sides are parallel to the long side of the casing 61 and so that its both major surfaces are inclined at an angle of 45° to the bottom surface 63 of the casing 61, as shown in Fig. 19. The bottom surface 63 represents the attachment surface to the circuit substrate 41.

**[0100]** By mounting the acceleration sensor 33 so that the long side of the casing 61 is inclined 45° relative to the lower side 41b of the major surface 41a of the circuit substrate 41, as shown in Fig. 17, impacts applied from a variety of directions can be detected. Meanwhile, it has been confirmed experimentally that, by mounting the acceleration sensor 33 at this angle, impact detection signals of a uniform strength can be obtained without regard to the direction of application of the impacts. That is, in the digital camera device 1, since the acceleration sensor 33 is mounted so that the major surface of the impact detection plate 62 of the acceleration sensor 33 will be approximately at an angle of 45° relative to the three axes

X, Y and Z shown in Fig. 16 in case the casing 2 is used in the basic position shown in Figs. 1 and 2, the impacts from the axial directions of X, Y and Z can be detected uniformly, such that a sufficient function can be manifested by a sole acceleration sensor.

**[0101]** Fig. 21 shows the mechanism around a magnetic head arranged in a casing 32b of the floppy disc drive 32. Within the casing 32b of the floppy disc drive 32 is mounted a head actuator 70, as shown in Fig. 21A. This head actuator 70 includes a head arm 73 formed as one with upper and lower arm members 71, 72, upper and lower magnetic heads 74 (74a, 74b) mounted on the distal ends of the arm members 71, 72, a feed motor 75 for moving the head arm 73 and a feed screw 76 mounted on a rotor of the feed motor 75. The head actuator 70 also includes a pin 77 mounted on the distal end of the arm member 73 for engagement with a spiral groove 76a formed in the feed screw 76 and a guide shaft 79 mounted in a through-hole 78 formed in the arm member 72 for guiding the movement of the head arm 73.

**[0102]** The arm members 71, 72 are molded from, for example, synthetic resin, and has upper and lower paired magnetic heads 74, 74 at the distal ends thereof, these magnetic heads being positioned on both sides of the major surfaces of the magnetic disc 9, as shown in Fig. 21B. Although not shown, a spindle motor for rotationally driving the magnetic disc 9 is mounted below the mid position of the major surface of the magnetic disc 9.

**[0103]** With the above-described head actuator 70, the magnetic head 74 is slid against the major surface of the magnetic disc 9, run in rotation by the spindle motor, for applying a magnetic field on the recording track of the magnetic disc or detecting magnetic signals recorded on the recording track of the magnetic disc in order to record or reproduce main picture data or thumbnail picture data.

**[0104]** The head arm 73 of the head actuator 70 is reciprocated along a guide shaft 79 in the radial direction of the guide shaft 79, that is in the direction indicated by arrow in Figs. 21A and 21B. Specifically, when the feed motor 75 is rotated a pre-set rotational angle, the head arm 73 is moved track-by-track on the recording tracks formed on the magnetic disc 9. If a strong impact is applied to the floppy disc drive 32 in its entirety, the casing 32b or the head arm 73 is flexed to cause position offset of the magnetic heads 74a, 74b relative to the recording track of the magnetic disc 9, or failure in contact, thus causing erosion of neighboring tracks during data recording or otherwise causing failure in writing on the current track.

**[0105]** In the case of the 3.5 inch 1/2 height floppy disc drive, as described above, it has been found by experiments that the G-value of occurrence of writing errors for the current recording tracks is 3G to 12G, with the G-value of occurrence of the erosion to the neighboring tracks being not less than 50G. It is therefore reasonable to select the setting value for impact detection of the acceleration sensor 33 to not less than approximately 50G for preventing erosion to the neighboring tracks and to

select the setting value for impact detection of the acceleration sensor 33 to a suitable value ranging between 3 and 12G for preventing error occurrence for the current track as well. It has been found by experiments that an optimum result can be obtained with the present digital camera device 1 by selecting the setting value for impact detection of the acceleration sensor 33 to 7G to 8G, in particular to approximately 8G.

**[0106]** The operation of the acceleration sensor 33 and the floppy disc drive 32 in case an impact is applied to the casing 2 of the digital camera device 1 from outside is explained with reference to Fig.22.

**[0107]** In the digital camera device 1, the track number and the sector number on the magnetic disc 9 for recording are set by the micro-computer 28 shown in Fig. 6 prior to proceeding to recording respective data. The track number is herein set to  $n$ . The micro-computer 8 then controls the FDC31 to move the magnetic head 74 to the track and sector positions by way of the seek operation.

**[0108]** At a time point  $t_0$  corresponding to the end of the seek operation, the micro-computer 28 outputs a reset signal to the flip-flop 35 to reset the output of the flip-flop 35, at the same time as a control signals is outputted from the FDC 31 to invert the output signal of the AND gate 36 to permit the data recording in the FDD 32.

**[0109]** Then, recording data is supplied from the FDC 31 to the floppy disc drive 32 to supply the recording current to the magnetic head 74 so that recording data is written on pre-set sectors of the track  $n$  as from time  $t_1$ . The time between  $t_0$  and  $t_1$  stands for the rise time until coming into operation of the floppy disc drive 32.

**[0110]** If an impact exceeding e.g., 8G is produced at time  $t_2$ , this impact is sequentially transmitted from the casing 2 via chassis 42, circuit substrate 41 and the acceleration sensor 33, which then outputs an impact detection signal. This detection signal from the acceleration sensor 33 is amplified by the amplification circuit 34 and thence supplied to the flip-flop 35 to invert the output thereof. The inverted output signal of the flip-flop 35 is sent to the micro-computer 28 and to the AND gate 36. This complements the output signal of the AND gate 36 to close the gate of the control signals from the FDC 31 for the floppy disc drive 32. Thus, the control current ceases to be supplied as from time  $t_2$  to the recording head 74 of the floppy disc drive 32, as shown in Fig.22.

**[0111]** Since the chassis 42 and the floppy disc drive 32 are interconnected via buffer members 45 to 48 adapted for delaying the impact transmission, this impact is transmitted at a timing delayed from the transmission timing to the acceleration sensor 33, herein a pre-set timing delayed from time  $t_2$ . Since no recording current is supplied at this timing to the magnetic head 74 of the floppy disc drive 32, it becomes possible to prevent erosion to neighboring tracks or failure in writing in the current track even on occurrence of detracking of the magnetic head 74 by impacts.

**[0112]** That is, in the present embodiment, since the time when the impact applied to the casing 2 is transmitted

to the floppy disc drive 32 can be retarded, the impact applied to the acceleration sensor 33 can be relatively quickened thus compensating for the time delay required for interrupting the recording current. In particular, if the casing 2 or the chassis 42 is of high tenacity, the speed at which the impact is transmitted to the magnetic head 74 of the floppy disc drive 32 is increased significantly, such that the recording current interruption after detection of the acceleration sensor 33 cannot be achieved in time. In such case, it is highly effective to interconnect the floppy disc drive 32 and the casing 2 with interposition of the buffer members 45 to 48, as shown in Figs. 16 and 18, because the impact transmission timing can then be retarded to permit the function of the acceleration sensor 33 to be performed more effectively.

**[0113]** It has been confirmed experimentally that, in the present embodiment, the time until the impact applied to the casing 2 is transmitted to the floppy disc drive 32 is  $11 \text{ msec} \pm 5 \text{ sec}$ .

**[0114]** If an output signal of the flip-flop 35, complemented on occurrence of the impact, is fed to the micro-computer 28 at time  $t_2$ , the micro-computer 28 outputs a control signal to the FDC 31 to move the magnetic head 74 to an original track of the track  $n$  by way of re-seeking control.

**[0115]** At a time  $t_3$  when the re-seeking comes to a close, a reset signal is outputted to the flip-flop 35. The output signal of the flip-flop 35 is complemented at time  $t_4$  corresponding to the decay time of the reset signal, this complemented signal being sent to the micro-computer 28 and to the AND gate 36. By the complemented output signal being sent to the AND gate 36, the output signal of the AND gate 36 is complemented at this time  $t_4$  to open the gate to permit data recording by the floppy disc drive 32.

**[0116]** The micro-computer 28 then controls the FDC 31 to supply the recording data from the FDC 31 to the floppy disc drive 32, with the recording data as from the recording start time  $t_1$  as the re-trial data. This furnishes the recording current for the re-trial data to the recording head 74 of the floppy disc drive 32 as from time  $t_5$ , as shown in Fig.22, thus causing the recording data to be written as from the pre-set sector of the track  $n$ . Meanwhile, the time interval since time  $t_4$  until time  $t_5$  is the rise time until actuation of the floppy disc drive 32.

**[0117]** The digital camera device 1 may be provided with a flash memory 29, as shown in Fig.23. In the embodiment of Fig.23, the DRAM 24, DRAM controller 25, micro-computer 28, flash memory 29 and the FDC 31 are interconnected over a common bus. With this configuration of the digital camera device 1, it is possible to store a version-up program in the flash memory 29 for version-up of the function of the digital camera device 1. Specifically, the floppy disc cartridge 8 having recorded therein a version-up program for compressing picture data by a system other than the JPEG system can be loaded on the floppy disc drive 32 in order to get the program read from the magnetic disc 9 into the flash memory to

achieve function expansion.

**[0118]** That is, since each block in the digital camera device 1 is controlled by the software program loaded in the RAM 28a of the micro-computer 28, a variety of version-up software programs can be stored in this flash memory 29 so as to operate in place of or assist the micro-computer 28.

## Claims

1. A portable data recording device for recording data on a disc-shaped recording medium (9), the recording device comprising:

a disc drive (32) for recording data on the disc-shaped recording medium (9), the disc drive (32) comprising a head unit for recording data and a head actuator unit (70) for positioning the head unit, the disc drive (32) being provided inside a casing (32b);  
an acceleration sensor (33) mounted with respect to the casing (32b) so as to detect an impact applied to the casing (32b);  
buffer members (45, 46, 47 and 48) interposed between the disc drive (32) and the casing (32b); and  
control means (28) for controlling a recording current supplied to the head unit according to an impact detected based on detection results from the acceleration sensor (33), the recording current being interrupted if the impact is such that a detected acceleration exceeds a pre-set acceleration value.

2. A device according to claim 1, in which:

the disc-shaped recording medium is arranged as sectors; and  
the control means (28) is operable, in response to the detection of an impact for which the detected acceleration exceeds the pre-set acceleration value, to control the head actuator unit (70) to start a re-seeking movement that moves the head unit to a starting position of a sector.

3. A device according to claim 2, in which the control means (28) is operable to reinstate the recording current and to permit the disc drive (32) to record data after completion of the re-seeking movement.
4. A device according to claim 3, in which the disc drive is arranged to record data with respect to a recording start time and a recording start position on the recording medium and, following an interruption to the recording current in response to an impact, the control means (28) restarts the recording of the data from the recording start time and the recording start

position on the recording medium (9).

5. A device according to any preceding claim, in which the acceleration sensor (33) comprises an impact detection plate (62) moulded substantially in the shape of a rectangular plate and arranged so that the major surface of the impact detection plate (62) is inclined at an angle of substantially 45 degrees relative to three orthogonal axes, a first axis of the three orthogonal axes being along a direction parallel to a moving direction of the head unit, and a second axis being along a direction normal to the major surface of the disc-shaped recording medium (9) that is disposed in the disc drive (32).
6. A device according to any preceding claim, in which the pre-set acceleration value is between 3 G and 12 G.
7. A device according to any preceding claim, in which the casing (32b) comprises a chassis (42) and a circuit substrate (41) mounted to the chassis (42), and in which the acceleration sensor (33) is mounted to the circuit substrate (41).
8. A digital camera (1) comprising a device according to any preceding claim.
9. A method of recording data on a disc-shaped recording medium (9) in a portable data recording device comprising a disc drive (32) provided inside a casing (32b) and buffer members (45, 46, 47 and 48) interposed between the disc drive (32) and the casing (32b) and in which the disc drive (32) comprises a head unit for recording data and a head actuator unit (70) for positioning the head unit, the method comprising the steps of:  
recording data on the disc-shaped recording medium (9) in the disc drive (32);  
detecting an impact applied to the casing (32b) with an acceleration sensor (33) mounted with respect to the casing (32b); and  
controlling (28) a recording current supplied to the head unit according to an impact detected based on detection results from the acceleration sensor (33), the recording current being interrupted if the impact is such that a detected acceleration exceeds a pre-set acceleration value.
10. A method according to claim 9, comprising the step of controlling (28) the head actuator unit (70) to start a re-seeking movement that moves the head unit to a starting position of a sector after the detection of the impact.
11. A method according to claim 10, comprising the step of controlling (28) the recording of the data by the

disc drive (32) after the re-seeking comes to a close.

12. A method according to claim 11, in which the disc drive is arranged to record data with respect to a recording start time and a recording start position on the recording medium, the method comprising the step of restarting the recording of the data from the recording start time and the recording start position on the recording medium (9) following an interruption to the recording current in response to an impact.
13. A method according to any one of claims 9 to 12, in which the pre-set acceleration value is between 3 G and 12 G.

5

10

15

20

25

30

35

40

45

50

55

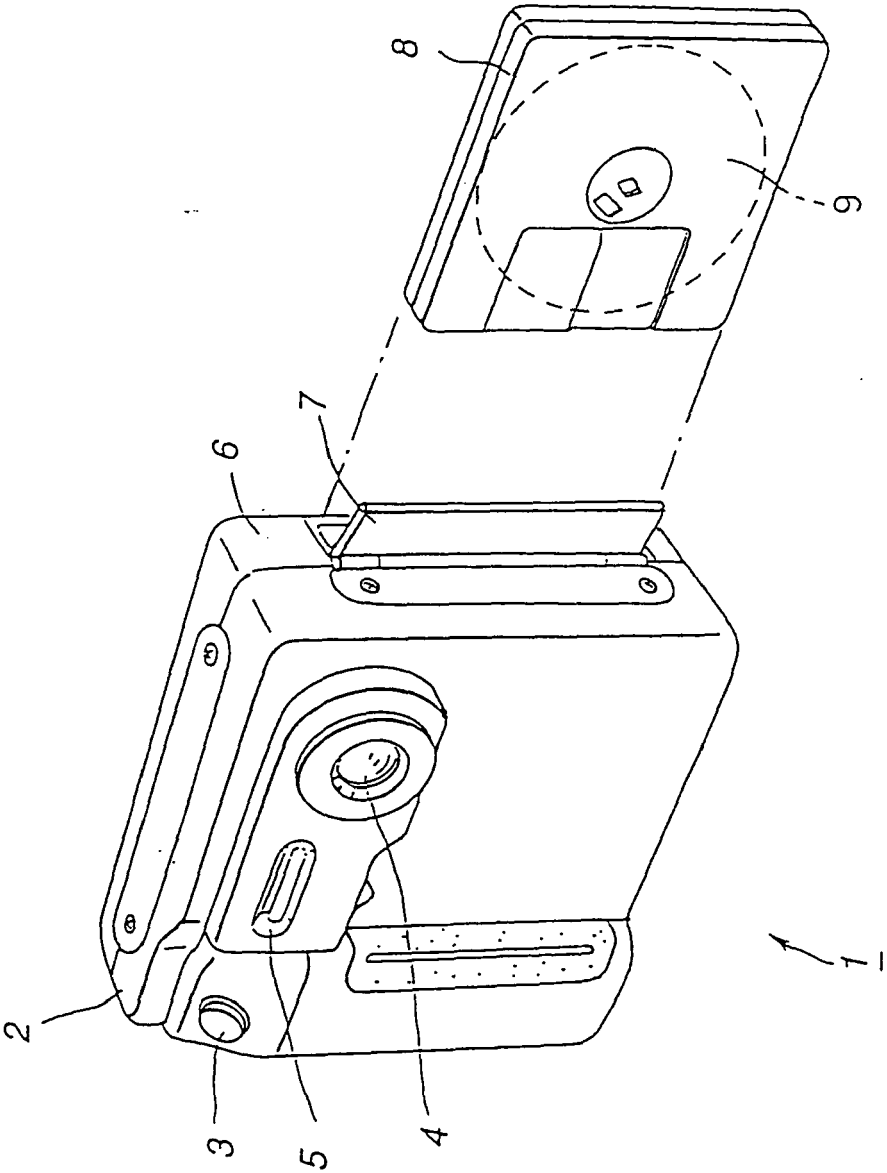


FIG.1

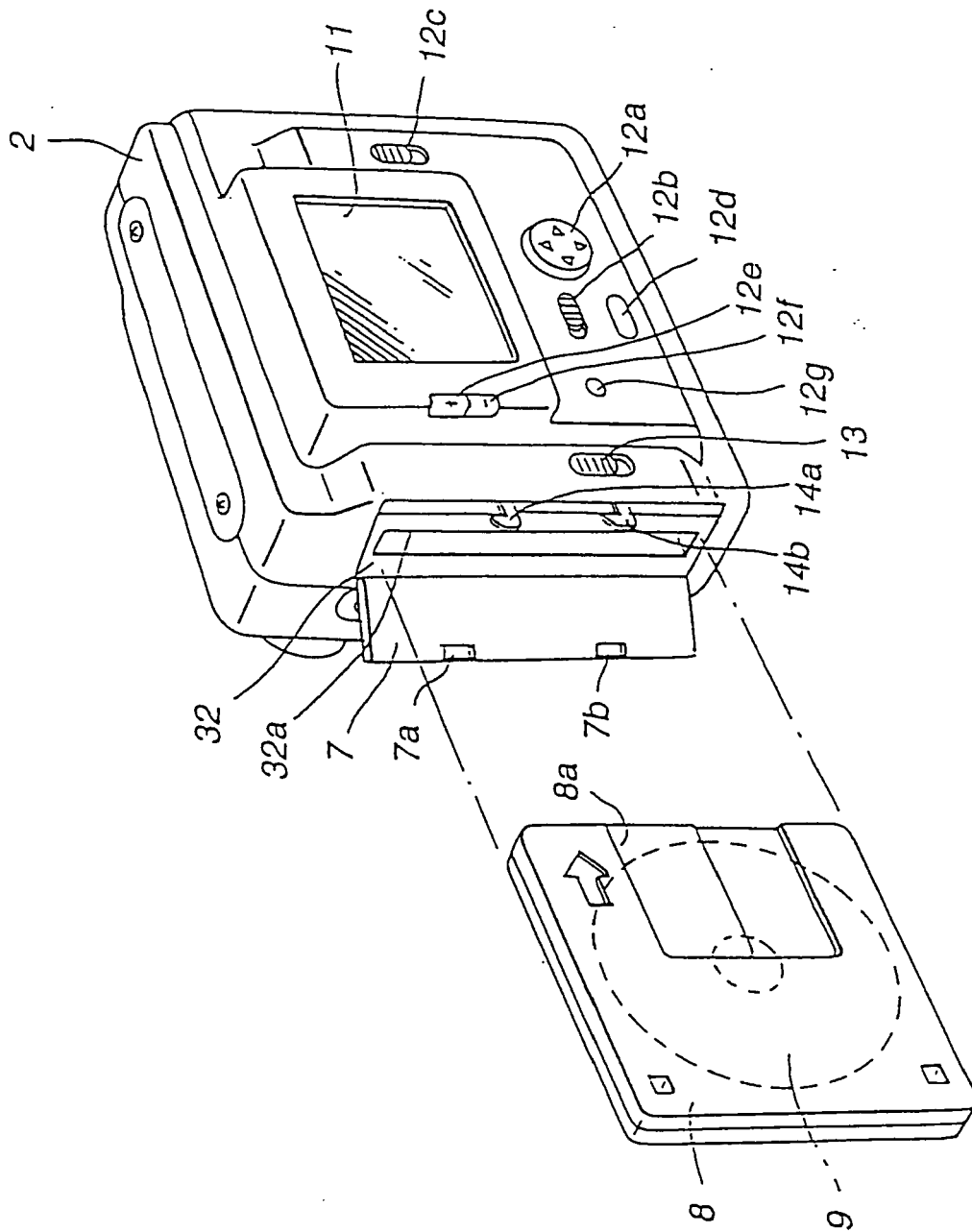


FIG. 2

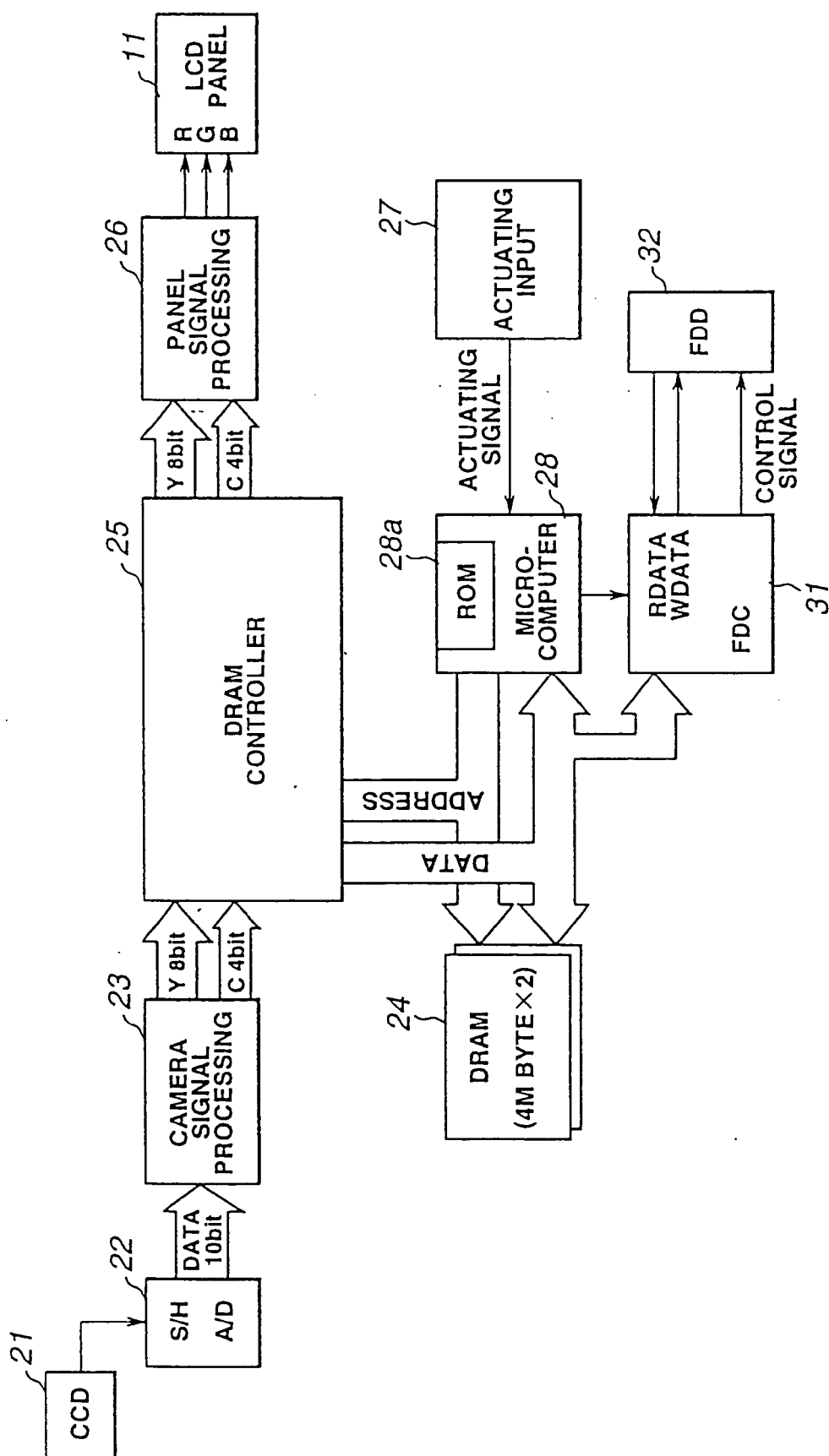


FIG.3

AREA 0	0000000 : 0ffffff	ENCLOSED ROM 64KB	8000000 : 8ffffff	NOT USED
AREA 1	1000000 : 1ffffff	NOT USED	9000000 : 9ffffff	DRAM 1MB
AREA 2	2000000 : 2ffffff	FDC RESISTER	a000000 : affffff	NOT USED
AREA 3	3000000 : 3ffffff	NOT USED	b000000 : bffffff	NOT USED
AREA 4	4000000 : 4ffffff	NOT USED	c000000 : cffffff	NOT USED
AREA 5	5000000 : 5ffffff	ENCLOSED PERIPHERAL MODULE	d000000 : dffffff	NOT USED
AREA 6	6000000 : 6ffffff	NOT USED	e000000 : effffff	FLASH MEMORY 256KB
AREA 7	7000000 : 7ffffff	NOT USED	f000000 : ffffff	ENCLOSED RAM 4KB

FIG.4

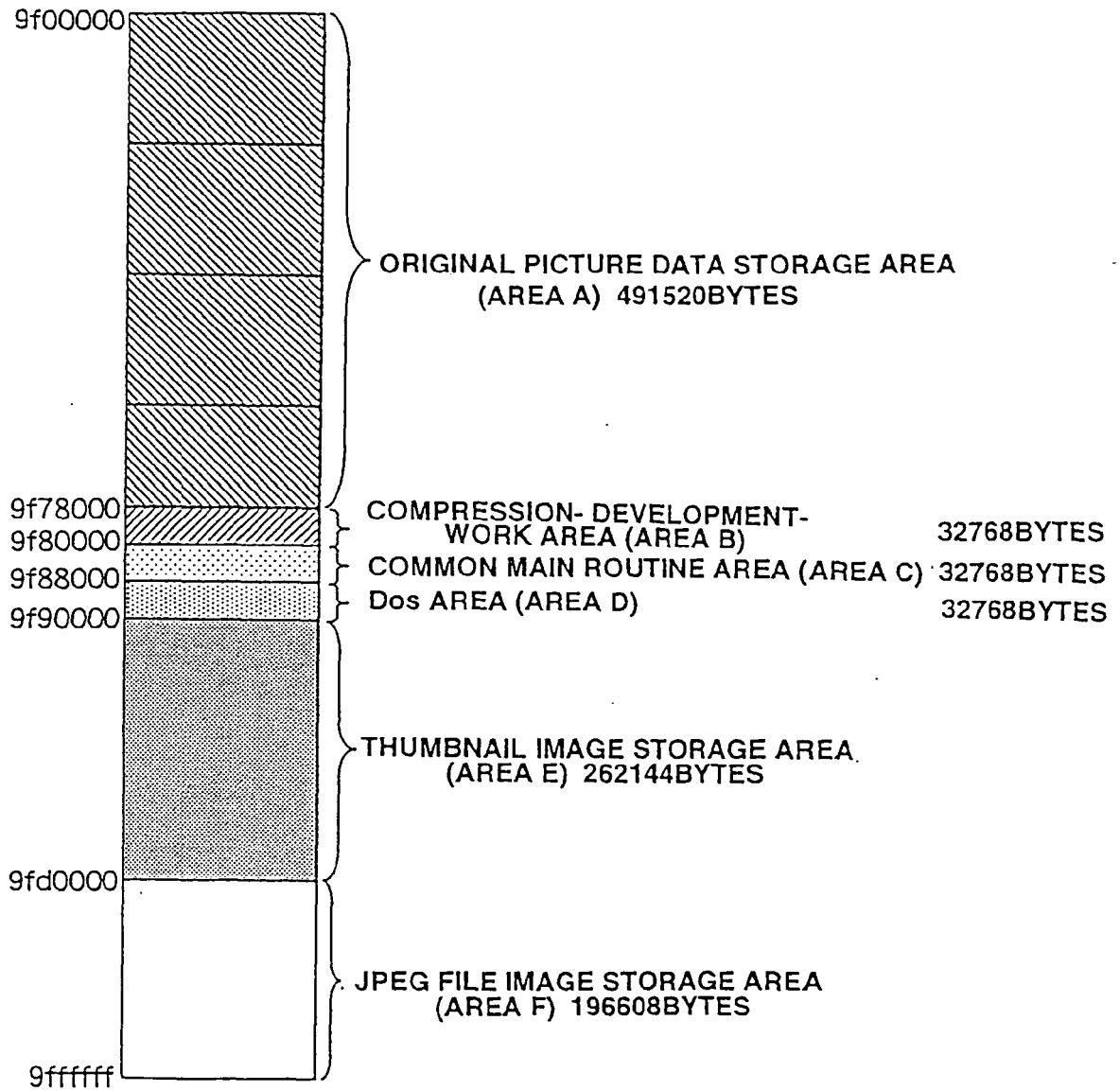


FIG.5

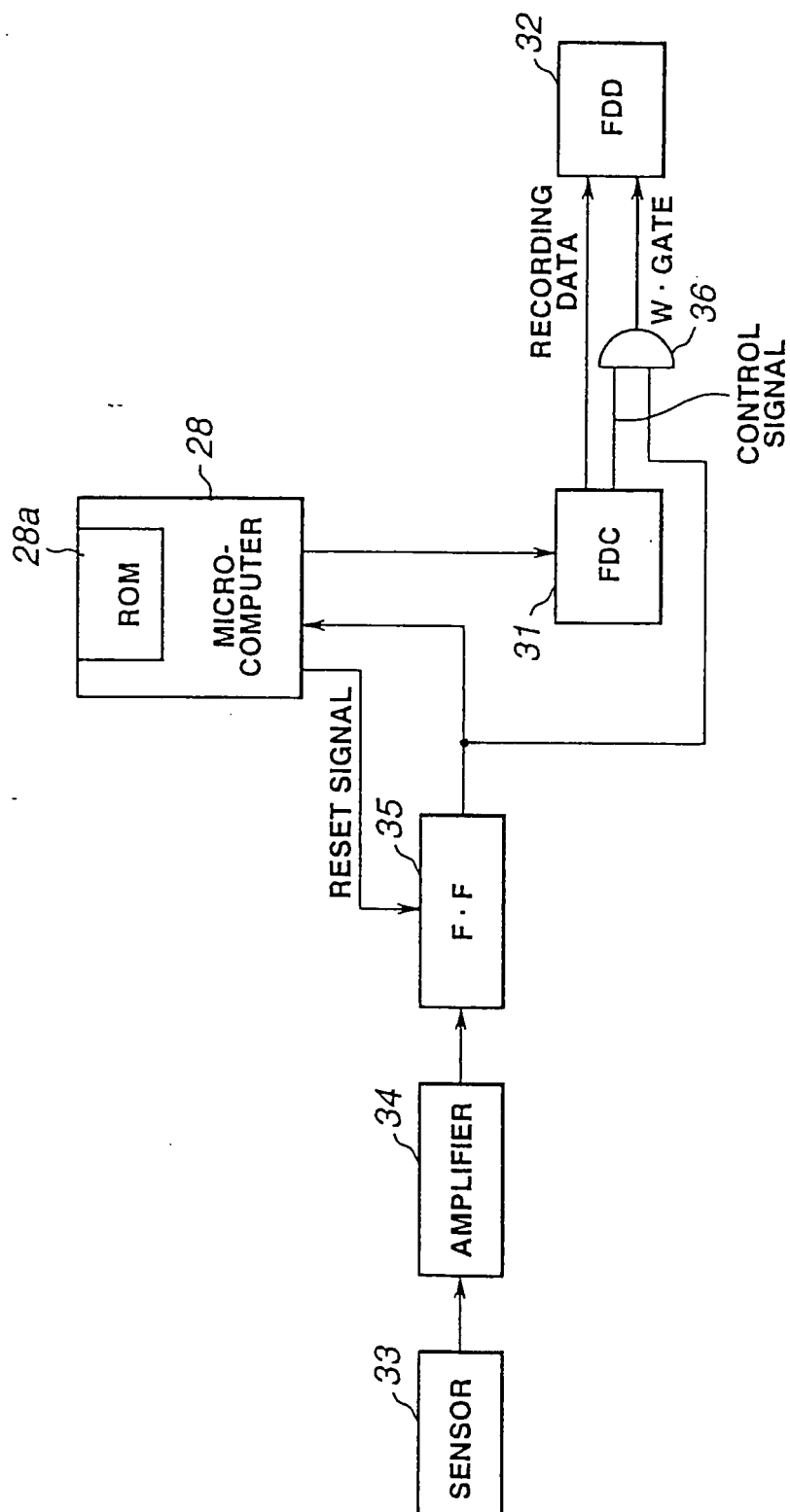


FIG.6

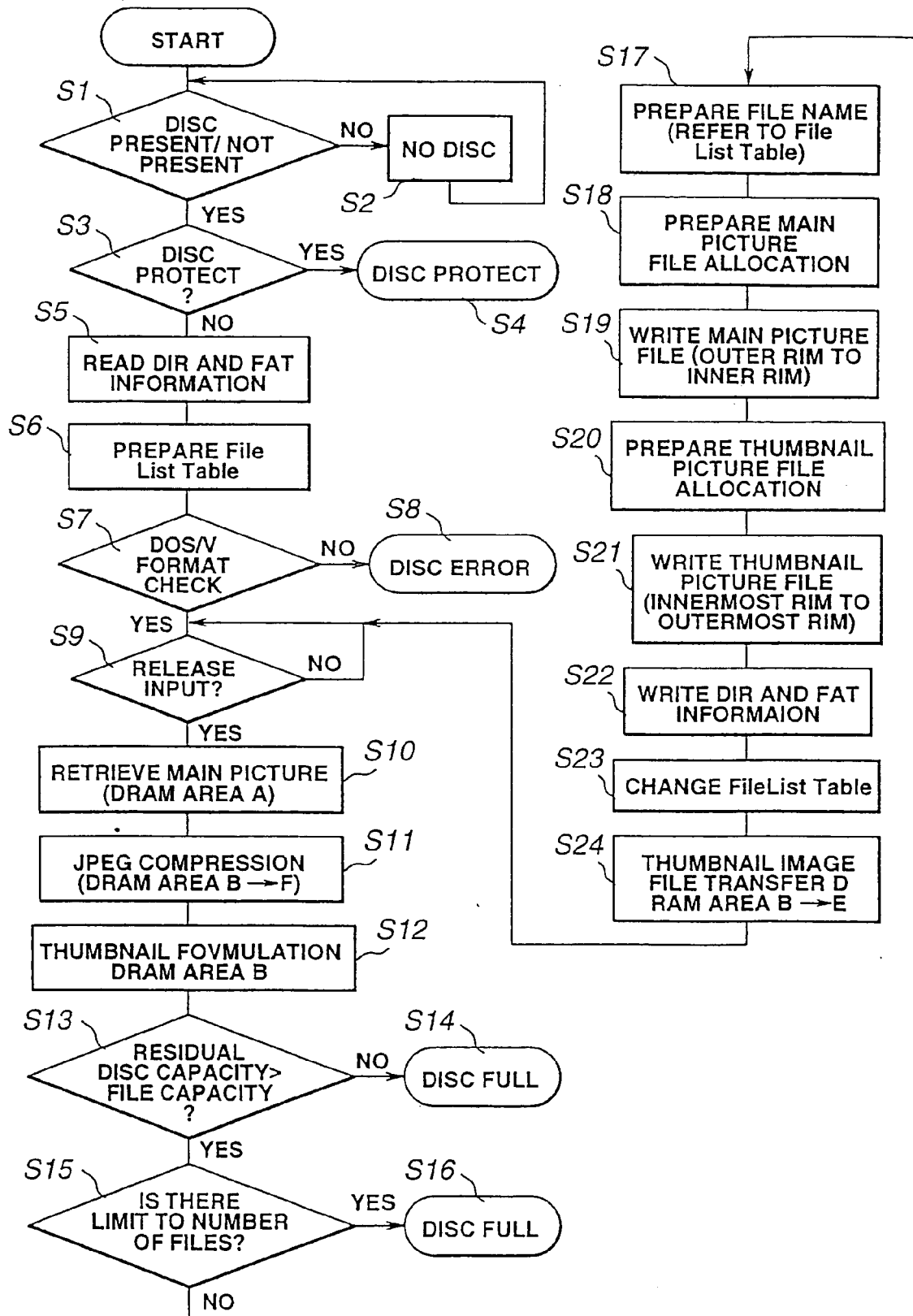
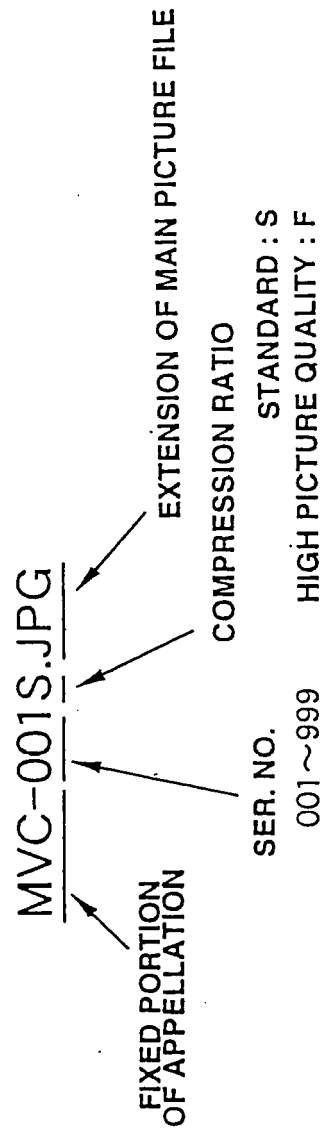


FIG.7



**FIG.8**

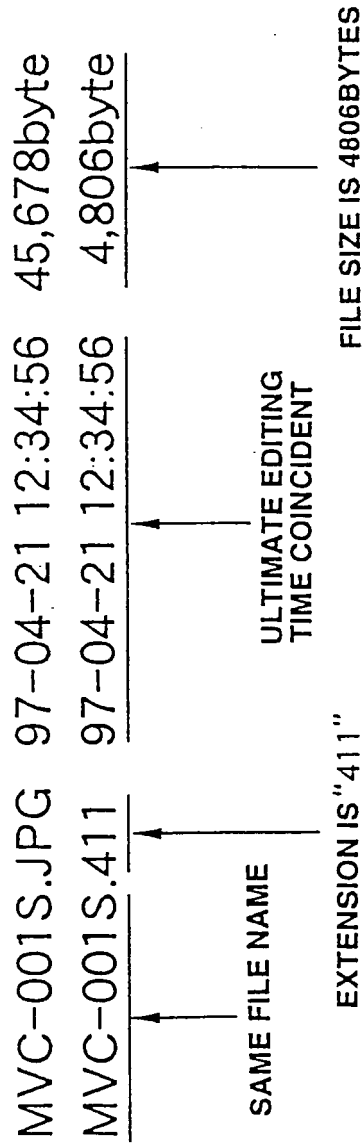


FIG.9

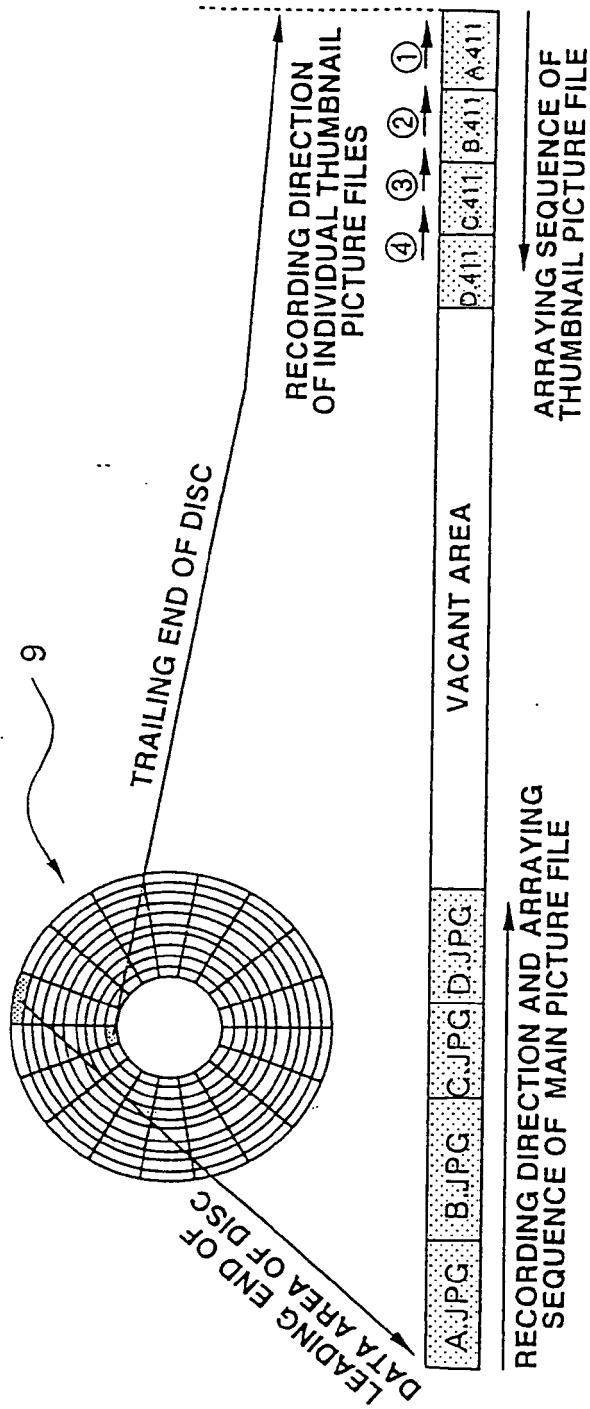


FIG.10A

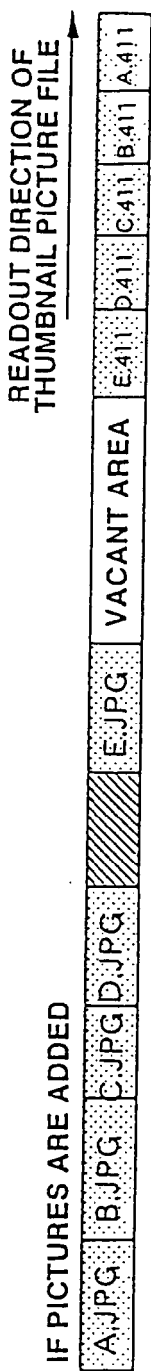


FIG.10B

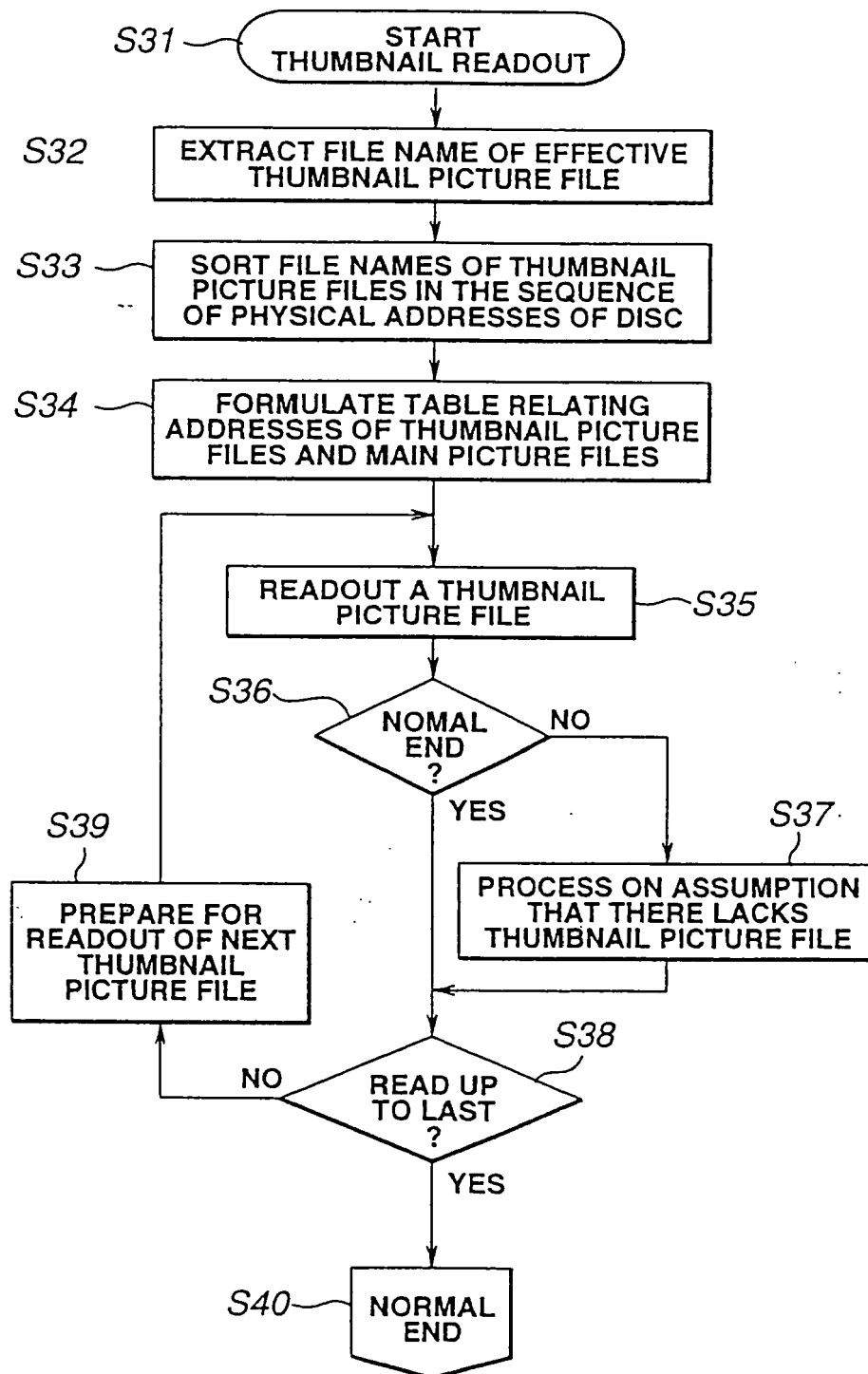


FIG.11

## DISC HYSTERESIS

001.JPG  
 002.JPG  
 (003.JPG)← DELETED BEFORE RECORDING 010.JPG  
 004.JPG  
 005.JPG← THUMBNAIL PICTURE FILE 005.411 WAS NOT REORDED  
 006.JPG  
 007.JPG  
 008.JPG  
 009.JPG  
 010.JPG← RECORDED AFTER DELETING 003.JPG

**FIG.12**

THUMBNAIL MANAGEMENT TABLE

FILE NOS.	MAIN PICTURE FILES	CORRESPONDING THUMBNAIL ADDRESSES
1	001.JPG	h
2	002.JPG	g
3	004.JPG	e
4	005.JPG	0
5	006.JPG	d
6	007.JPG	c
7	008.JPG	b
8	009.JPG	a
9	010.JPG	f

**FIG.13**

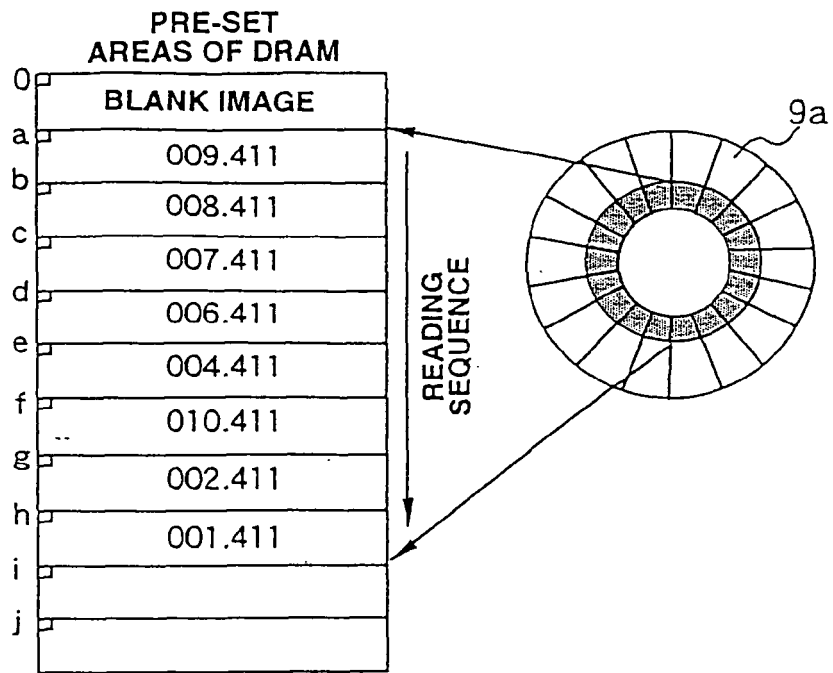


FIG.14

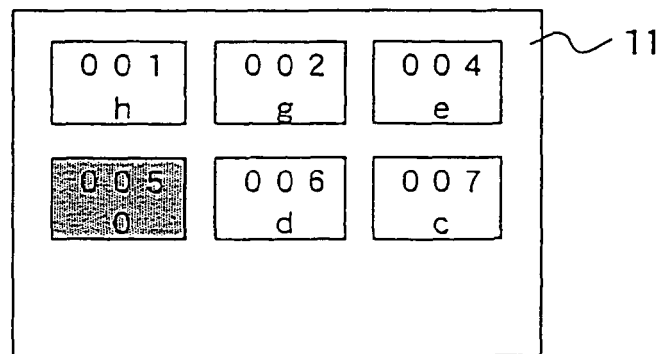
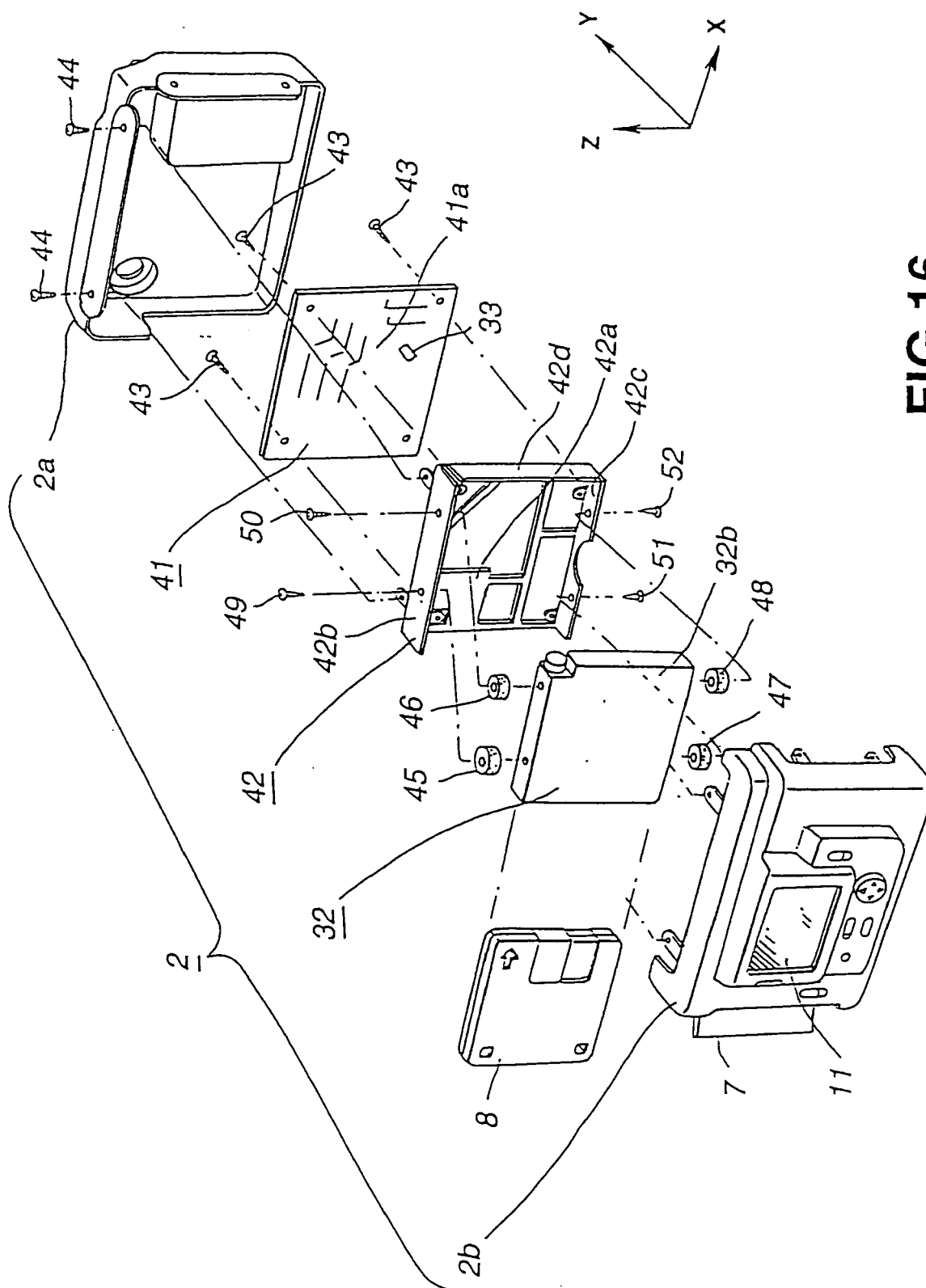
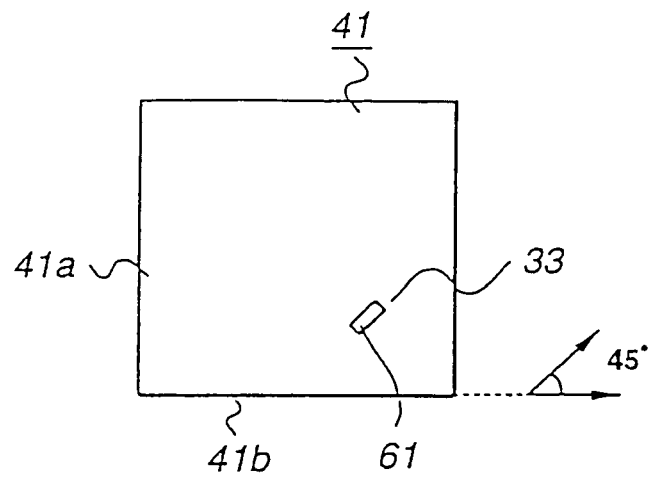


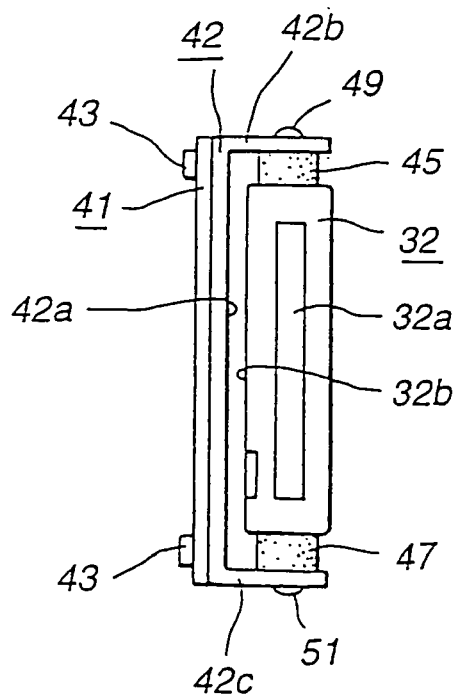
FIG.15



**FIG. 16**



**FIG.17**



**FIG.18**

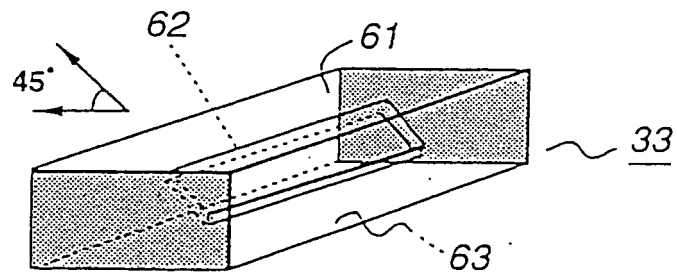


FIG.19

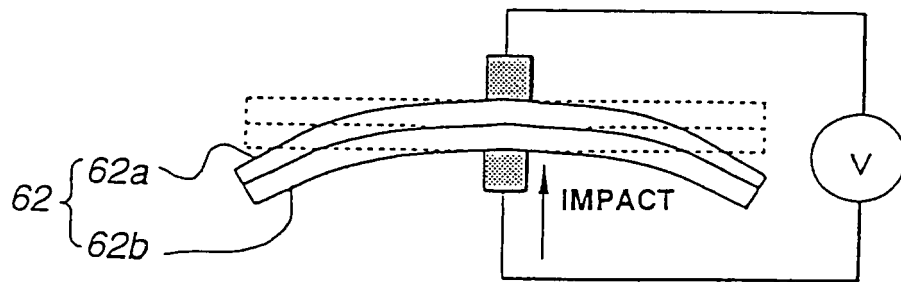
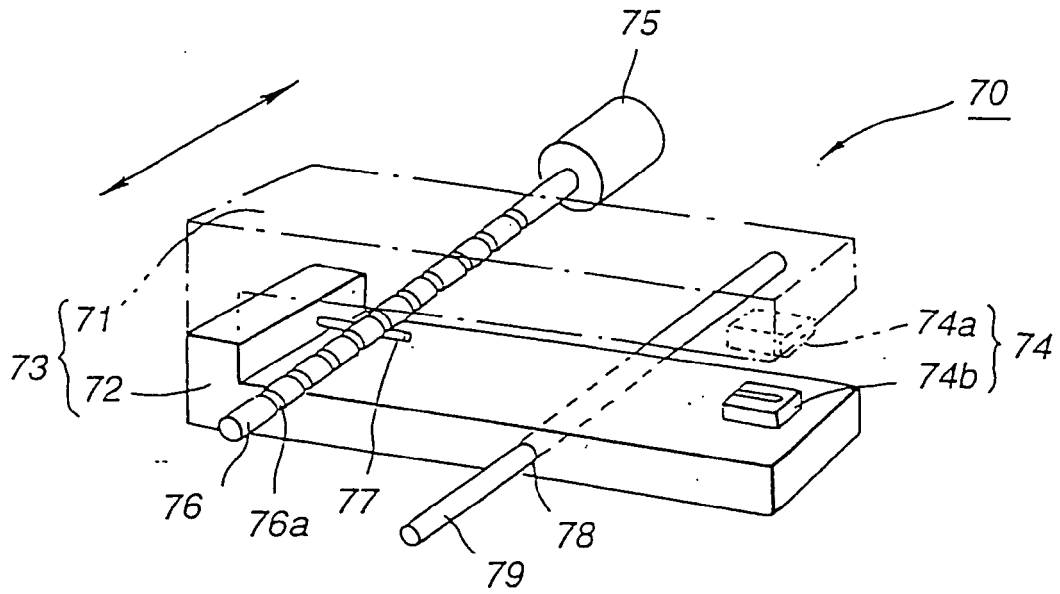
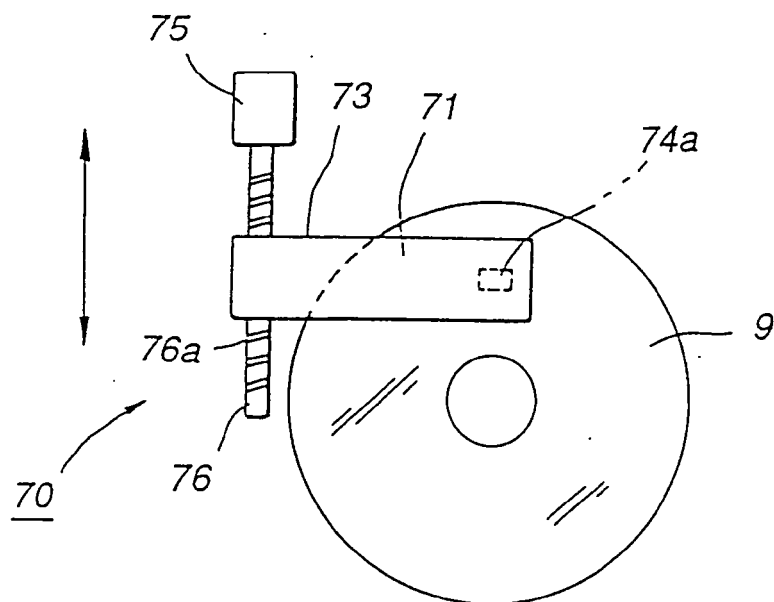


FIG.20



**FIG. 21A**



**FIG. 21B**

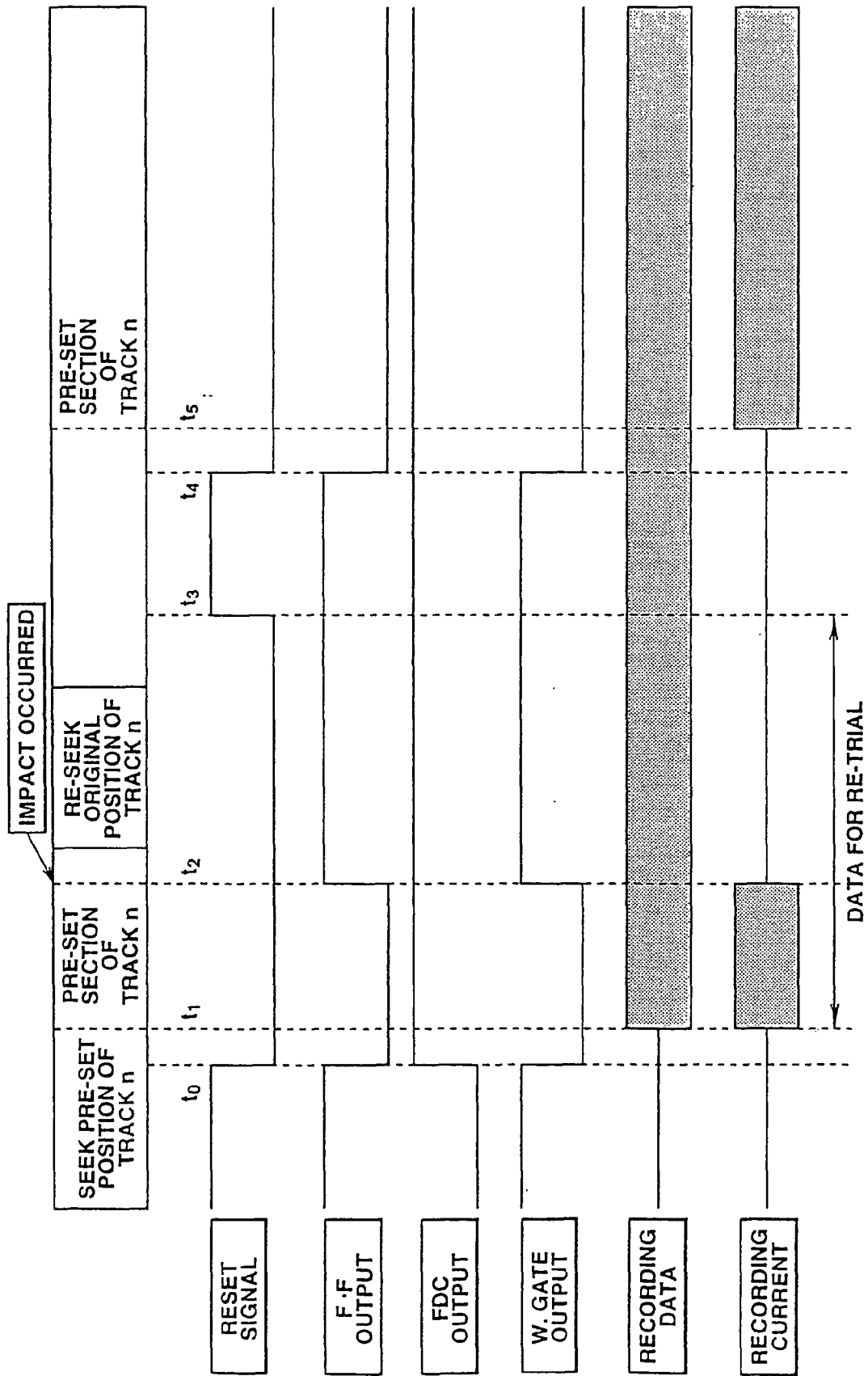


FIG.22

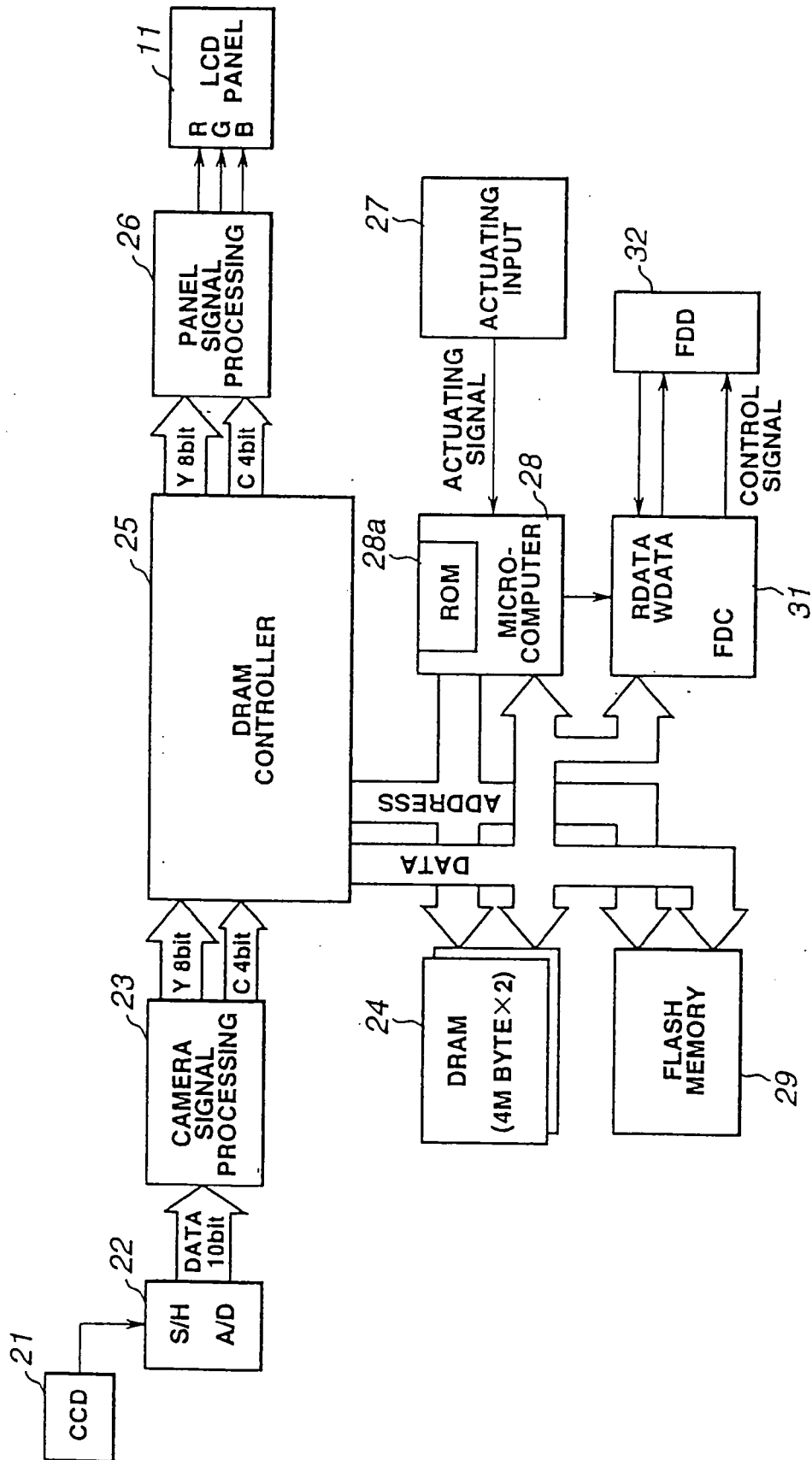


FIG.23